The Conference Board
Economic Research Program

70th Anniversary

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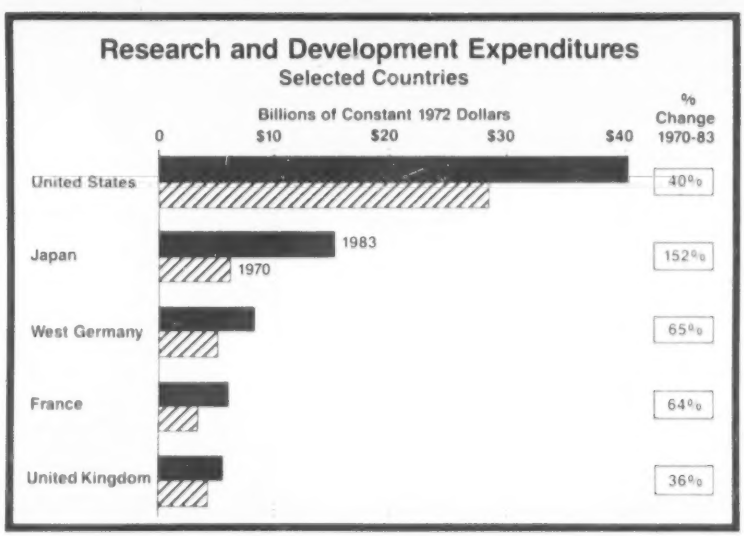
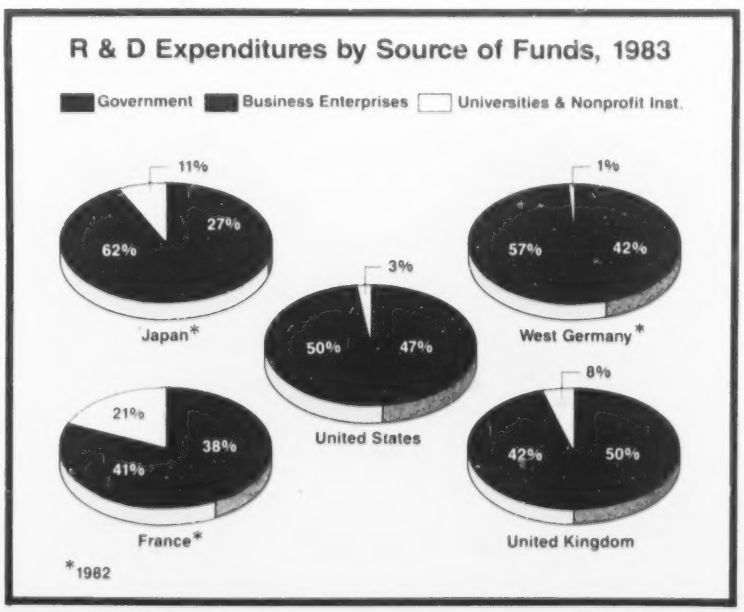
Research and Development

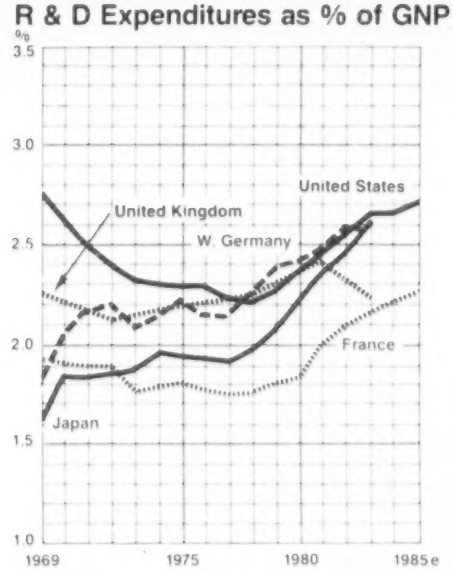
Economic Road Maps
Nos. 2007-2008

October, 1986

Investment in Research and Development (R&D) is an essential ingredient of technological innovation, a factor contributing to economic growth and competitiveness, and, as a result, an improved national standard of living. In absolute terms, the United States spends more on R&D than any other Western industrial country. However, in recent years some countries' outlays have grown at a much faster rate.

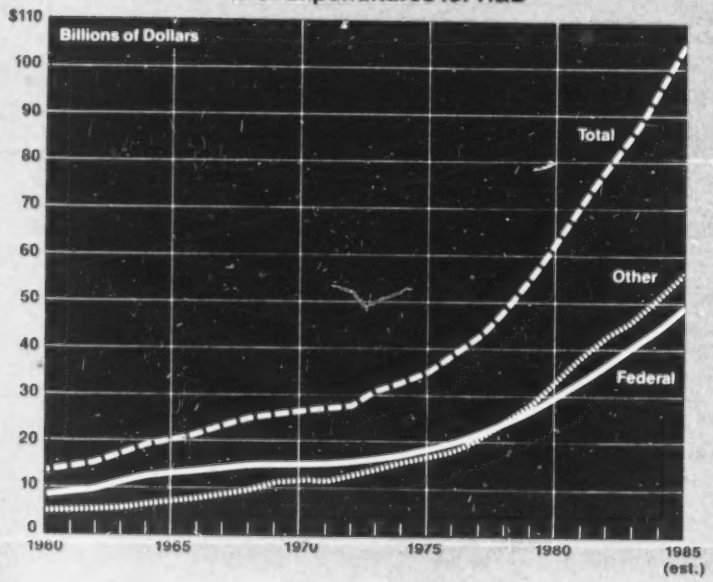


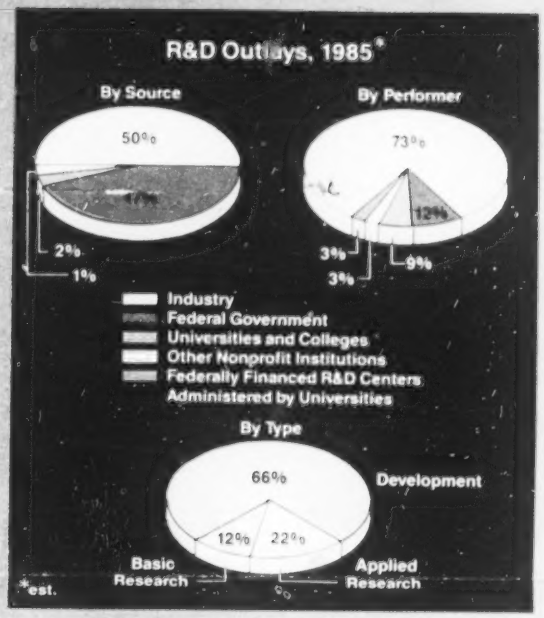




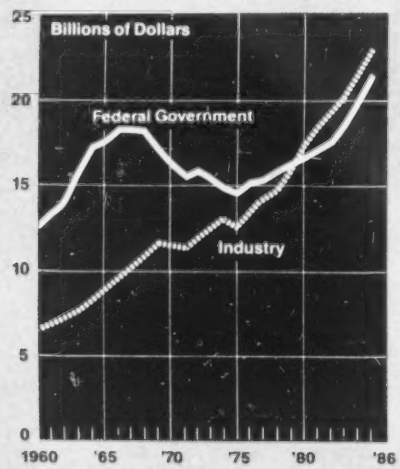
- U.S. expenditures on R&D were somewhat larger than the combined expenditures of Japan, West Germany, France and the U.K. in 1983, the latest year for which comparable date are available. But since the early 1970s all these countries, with the exception of the U.K., had higher growth rates than the United States.
- In the immediate post World War II era, the United States had the highest R&D/GNP ratio; but that dominant position was eroded in subsequent years until by 1978, both West Germany and the U.K. were ahead of the United States. However, from 1983 on this country began to reestablish its preeminence.
- The U.S., France, and the U.K. devote relatively higher shares of their R&D resources to defense-related activities than do West Germany and Japan. Those two countries, on the other hand, support a larger civilian research effort.

U.S. Expenditures for R&D

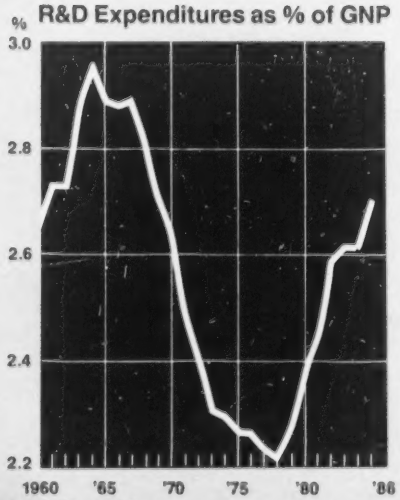




R&D Expenditures in 1972 Dollars



R&D Expenditures as % of GNP

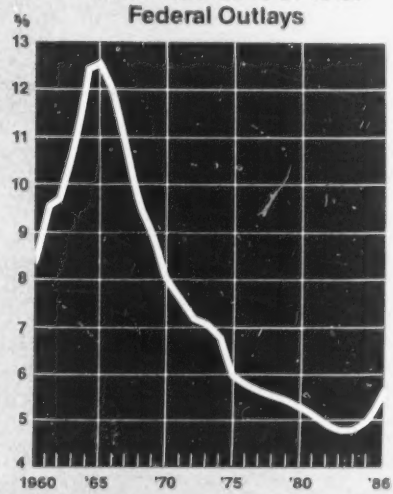


1983 preliminary
1984 and 1985 est.

- In the United States, R&D expenditures have shown strong growth since the mid-1970s with $107 billion spent in 1985. Spending by industry accounted for 50% and by the Federal government for 47% of the total, with the remaining 3% spent by the academic sector and nonprofit organizations.
- In recent years, Federal government funds went to support both defense as well as nondefense basic research, but the growth in the government's involvement remained moderate as the Administration considered the private sector a more suitable initiator of technological effort. Industry R&D funding has lately centered on increased spending by high-technology firms.
- Industry performs almost three-quarters of current R&D in the U.S., accounting for 73% of all expenditures in 1985. Even higher ratios were attained in the early 1960s; they declined in later years, and only lately approached again the high levels of 25 years ago. The Federal government's performance fluctuates according to shifts in its R&D priorities, with 12% of R&D performed by this sector in 1985.

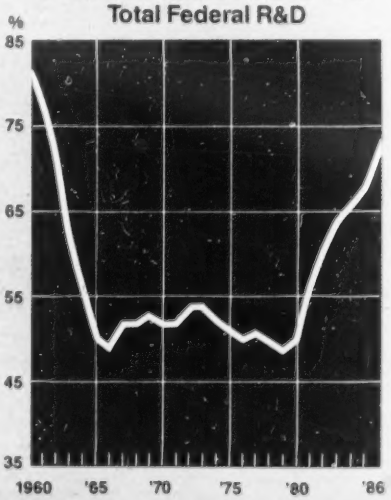
Support for basic research has increased during the past quarter century—from under 9% in 1960 to approximately 12% of the total in 1985; this ratio has held fairly steady since 1976. Primary support for basic research comes from the Federal government, which funded two-thirds of all investment in basic research in 1985. As a result of faster growth in industrial support, however, the Federal share of to-

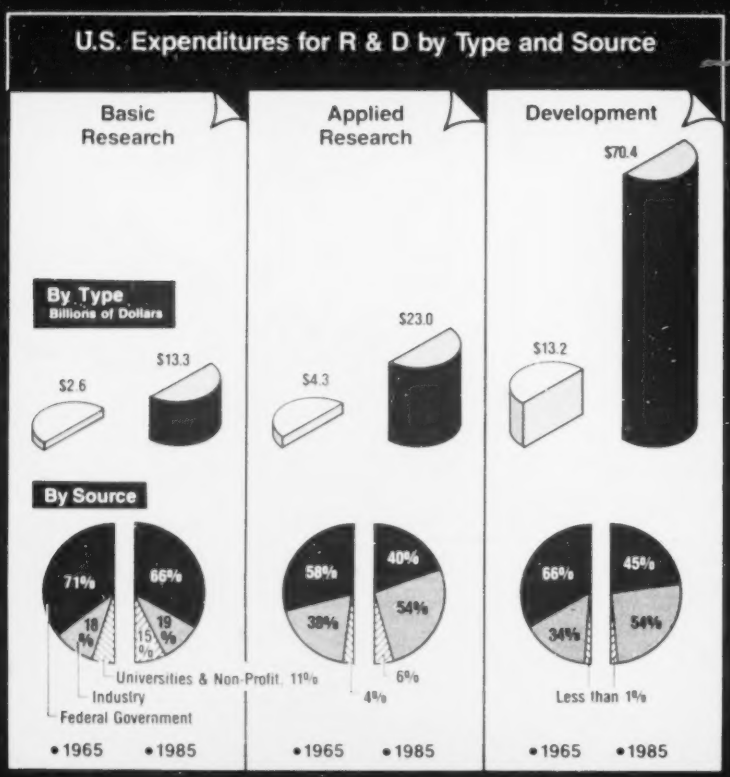
Federal R&D as % of Total Federal Outlays



1984 and 1985 est.

Defense Related R&D as % of Total Federal R&D





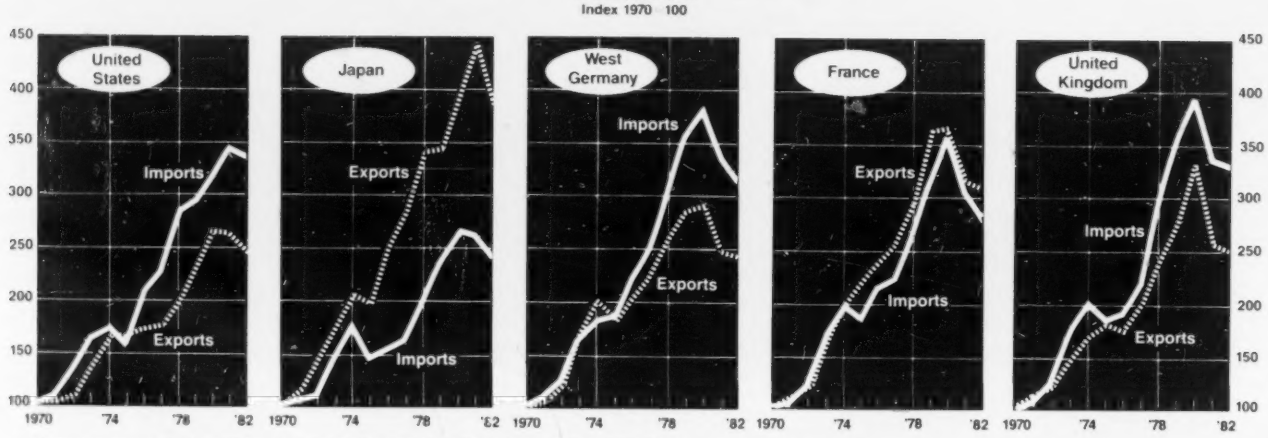
tal R&D has declined. Between 1980 and 1985, industrial support grew at an average annual rate of 8.5%, against growth of 3.7% for Federal support. In spite of the increased involvement of industry in basic research, such activity accounts for only a small portion of industry's R&D support.

• Funding for applied research is usually around 20% of the total, but there has been a change in the composition —since 1980 Federal support, which predominated in the past, has been replaced by industry.

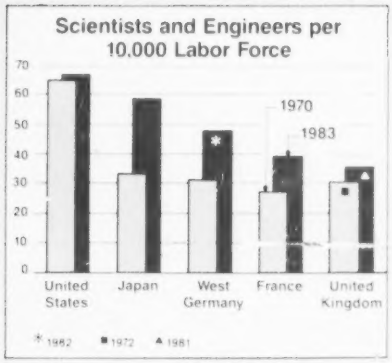
• The major portion of total R&D expenditures goes into development—66% in 1985. While Federal support is smaller than that of the private sector, it has grown considerably faster in recent years. Between 1980 and 1985, government funding of development increased at an average annual rate of 7.1% against a growth of 4.1% for industry, mainly as a result of defense R&D expenditures.

• The strength of a country's R&D effort can be measured in relation to its overall economic growth. In this country, the ratio has recovered substantially, from a low of 2.2% in 1978 to 2.7% in 1985. This rise reflects a vigorous growth of R&D expenditures in the face of slower growth in economic activity. Measured in constant dollars, R&D expenditures grew at an average annual rate of 5% between 1976 and 1985, compared with GNP growth of only 2.7 percent.

• Over the years, the United States recorded a substantial trade surplus in high-technology products, even as the balance on other manufactures sank into an ever-deeper deficit. But since 1980, even the high-tech trade balance has declined. Between 1980 and 1983 the high-tech trade surplus, measured in constant dollars, fell by over 40% (and is expected to decline further in 1984). However, imports of high-tech products by our major trading partners also fell by about 65% in the corresponding period. As a result, U.S. exports actually captured a slightly higher share of the international market in spite of the extraordinary strength of the dollar.



Technology-intensive products are defined as those for which R & D expenditures exceed 2.36% of value-added.



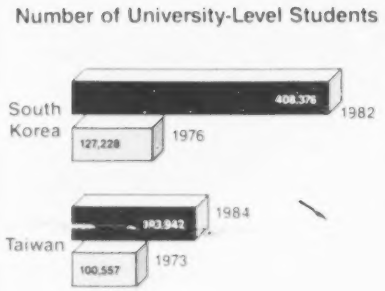
• In the long run, the training and availability of a competent scientific and engineering work force is an essential factor for technological innovation. While the United States has by far the largest such labor force, there is a strong and growing presence of foreign nationals in U.S. universities, especially at the graduate level. Today half of the doctoral degrees in engineering go to foreign students, up from about 23% twenty years ago. The ratio is high in other scientific fields as well.

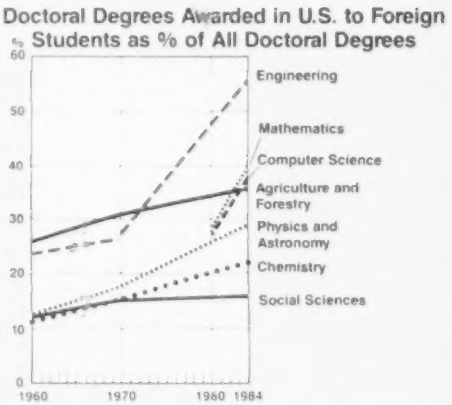
• There has also been a great surge in university-level training in the newly industrialized countries (NICs) in East Asia. Thus, South Korea, which in the mid-1970s had only one-fifth the number of students in engineering and science as did Japan, increased its share by 1982 to more than two-thirds of the Japanese total. Keeping in mind that these countries' presence in international trade in high-tech products is growing fast, the implications for U.S. trade in these products are evident.

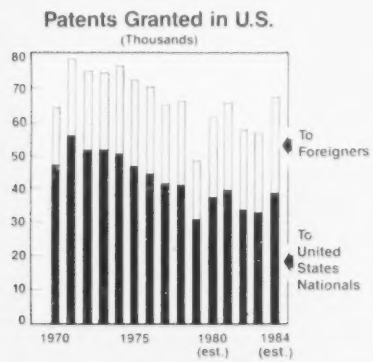
• In each year of the 1980s fewer patents have been granted in the United States than in the 1970s. Moreover, there has also been a decline in the proportion of patents issued to U.S. citizens, along with a rise in the average number awarded in the U.S. to foreigners, especially the Japanese.

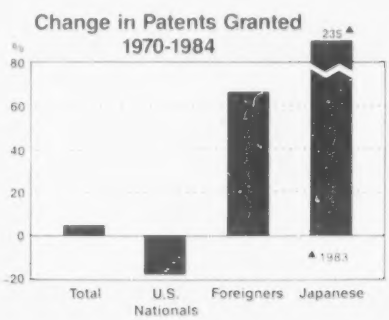
Eva Culen

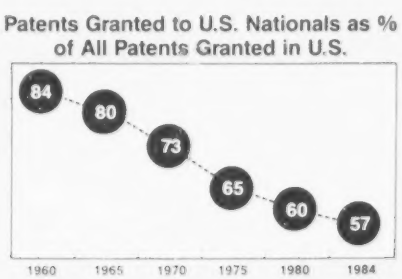
Sources: National Science Board; Joint Economic Committee; The Conference Board.











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Productivity: 1960-1986 An International Comparison

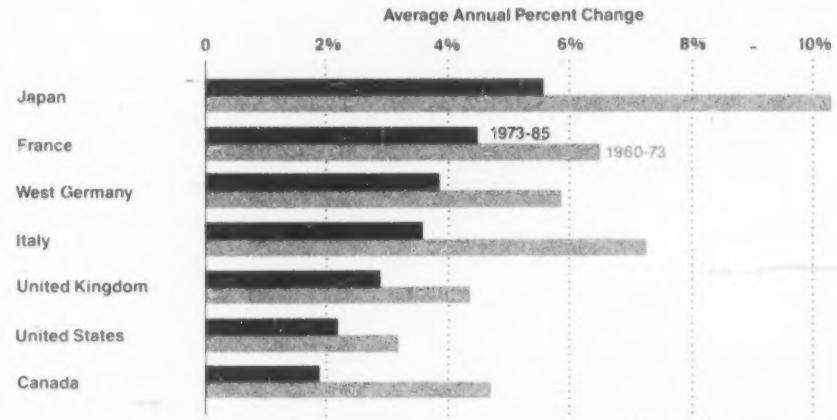
Economic Road Maps
Nos. 2009-2010
April, 1987

Advances in productivity are crucial to economic growth and increases in standards of living. Increasing productivity makes more goods and services available, raising the standard of living.

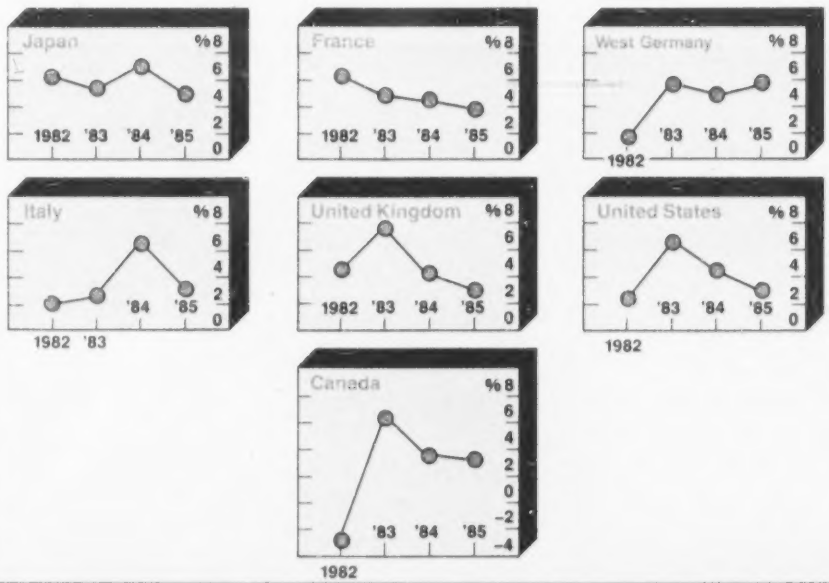
Throughout history, productivity has continually increased in nearly every country. Productivity advanced with unusual speed in the first two decades after World War II. More recently, however, the increase in productivity has been slowing in most countries. In addition, differences in the levels of productivity narrowed among industrial countries.

25 Years of Productivity Growth

(Output per hour in manufacturing)

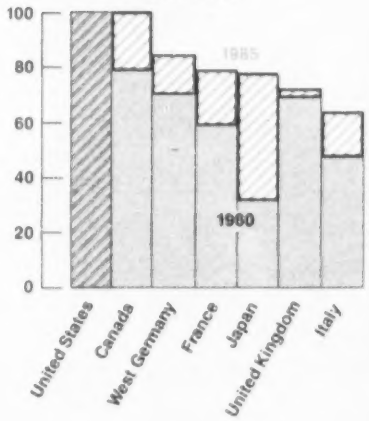


. . . and Recent Trends



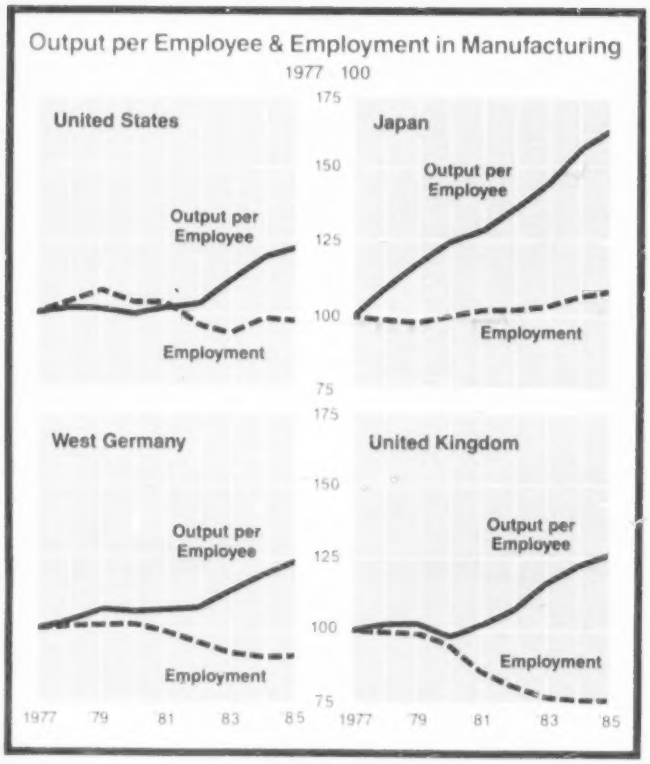
Real Gross Domestic Product Per Capita

U.S. = 100



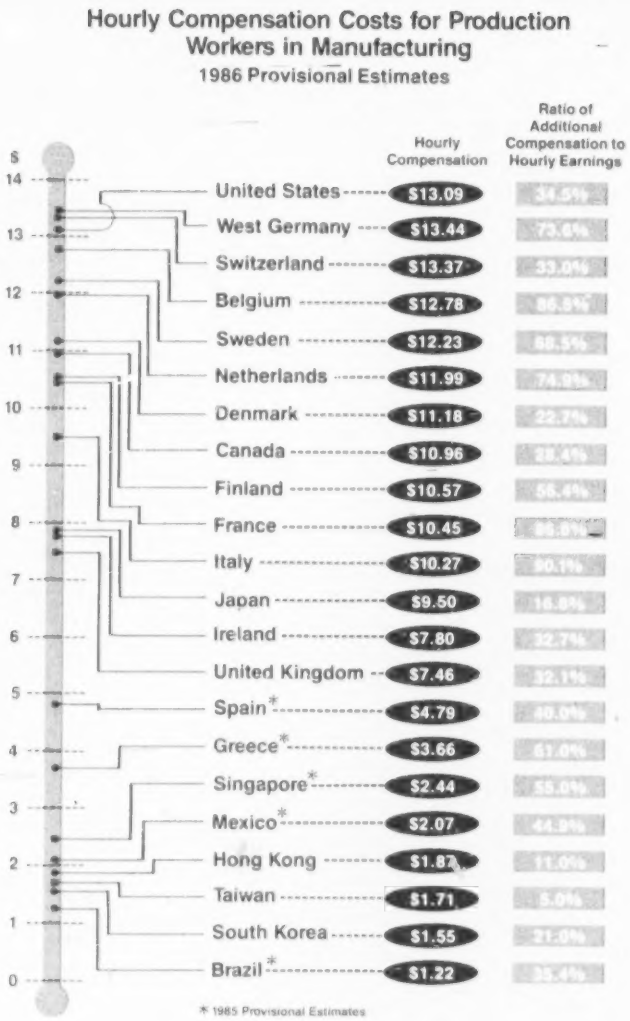
But back in 1960 the major industrial economies showed very divergent productivity levels. Measured productivity in the manufacturing sector in Japan was only one-third the U.S. level. Italy's productivity was about one-half, and France's just under two-thirds, the U.S. level. West Germany and the U.K. had productivity levels just over two-thirds that of the U.S. and Canada's productivity was about three-quarters of the U.S. rate.

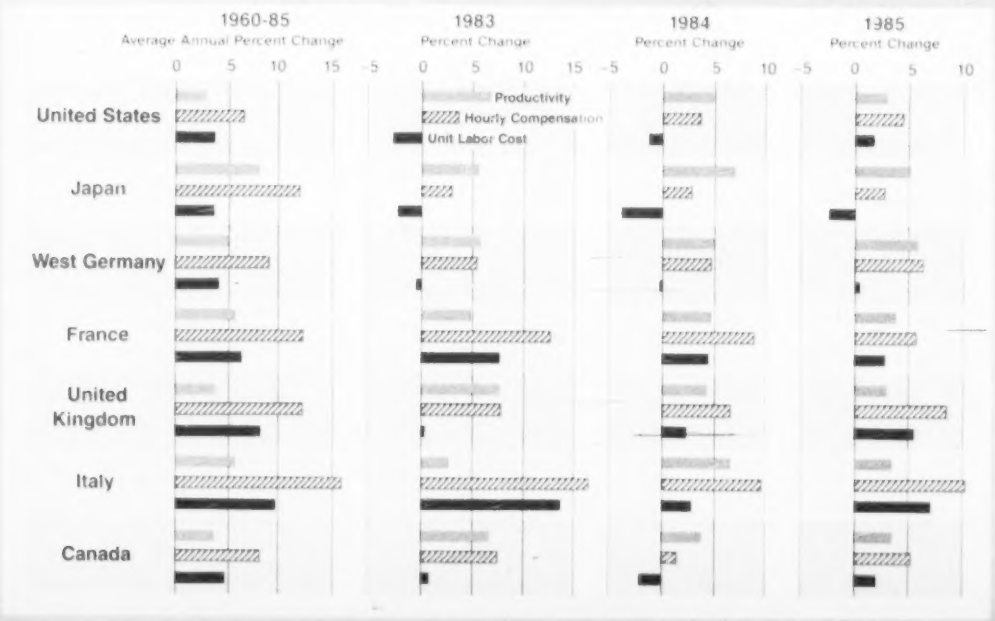
Between 1960 and 1973, U.S. productivity rose by an average of 3.2% per year, an above-average performance. Yet during the 1960's, the other six industrial countries all achieved higher—in some cases, substantially higher—productivity gains: Japan had a 10.3% annual gain, Italy 7.3%, France 6.5%, and West

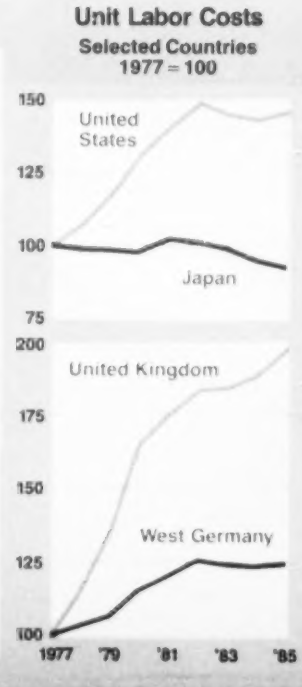


Germany 5.8 percent. Even the U.K. and Canada achieved slighly higher productivity gains than the U.S.

During 1973-1985, gains in productivity were uniformly lower than those experienced during 1960-1973. Recessions in the mid-1970's and again in the early 1980's, as well as the two oil-price shocks, affected productivity growth. Also, at least for some of the latter period, economic policies were more concerned with fighting inflation than with stimulating economic growth. Slower growth contributed to slower productivity gains.







Most industrialized countries were affected. Japan's rate, for example, was 5.6% per year between 1973-1985, down from 10.3% between 1960-1973. In Italy, productivity growth slowed from 7.3% to 3.6 percent. And in Canada, it fell from 4.7% to only 1.9 percent.

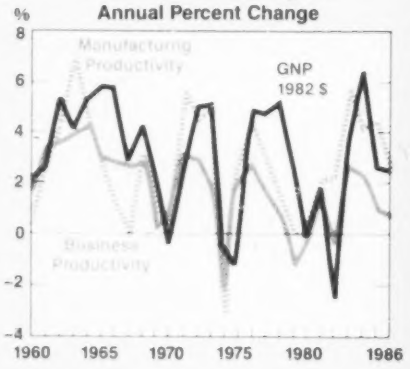
The slide was less pronounced in the other four countries: in France from 6.5% to 4.5%; in West Germany from 5.8% to 3.8%; and in the U.K. from 4.3% to 2.8 percent. The decline was least pronounced in the U.S.: from 3.2% to 2.2 percent.

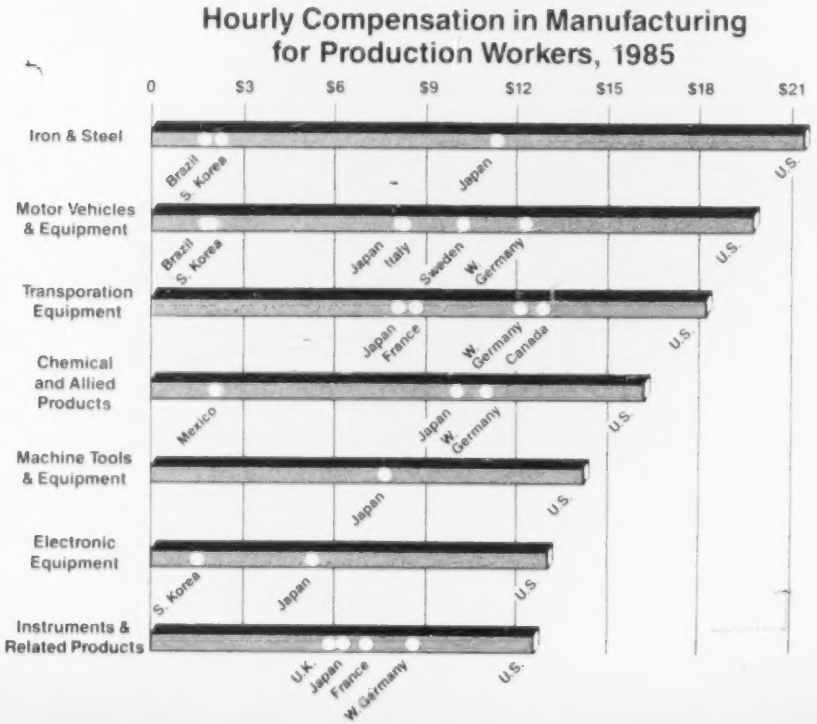
For the developed countries, productivity gains in the manufacturing sector continued to run above the U.S. rate through the mid-1980's. As a result, the differing manufacturing levels of productivity converged. By 1985, Canada's productivity level equaled that of the U.S.; Japan, France, and West Germany were not far behind.

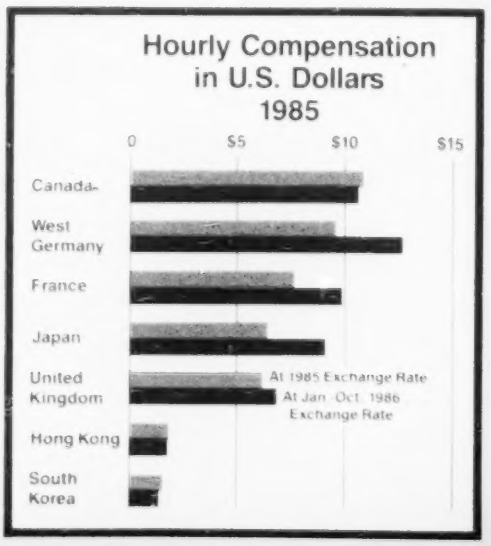
Italy's level of productivity equaled that of the U.K. by 1985, and reached two-thirds the U.S. level of output per worker-hour. Productivity in the U.K., conversely, was no closer to the U.S. level in 1985 than it was in 1960.

To a large degree, wages reflect productivity levels. But although productivity levels in the U.S. and Canada were about equal in 1986, the average hourly wage in U.S. manufacturing was $13.09, while Canada's was $10.96 (both measured in U.S. dollars.) And since U.S. workers generally pay less tax, the difference in take-home pay was a little more pronounced. However, the falling dollar closed the gap in some instances.

Will productivity growth rates start to rise faster? Many signs seem favorable.



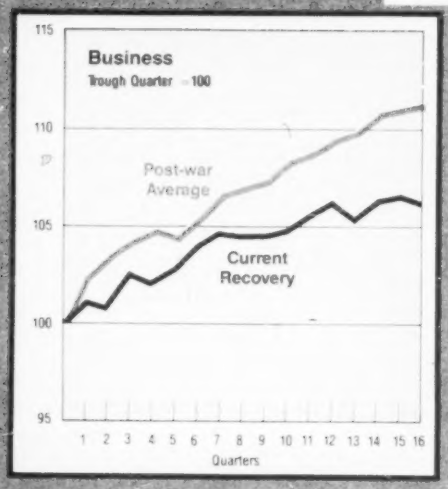


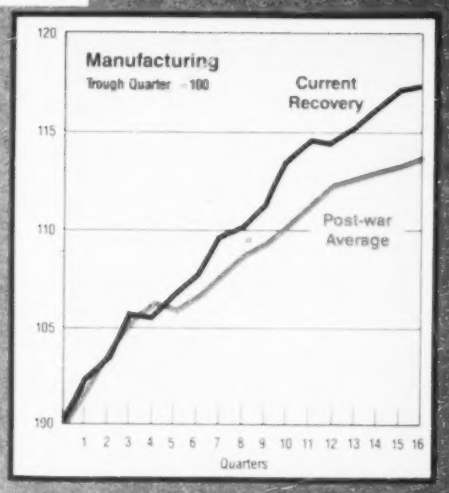


U.S. Productivity, Unit Labor Costs & the Business Cycle

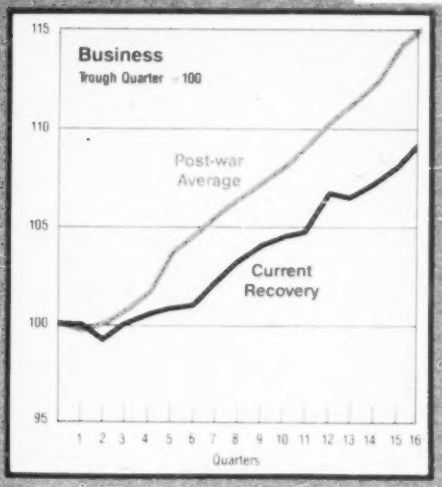
(16 Quarters after the Trough)

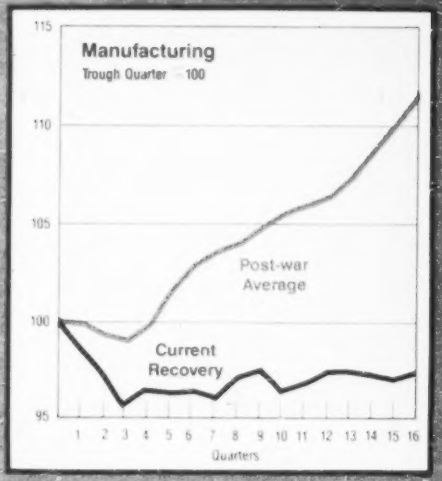
Productivity





Unit Labor Costs





The most recent oil-price shock resulted in a sharp reduction in price, not an increase. Economic policy has been shifting toward accommodating economic growth rather than fighting inflation, which remains reasonably in check.

However, even with all of these positive forces, productivity growth rates may not start to rise faster. One factor is the growing role of services in developed countries. It has always been easier to generate productivity gains, by substituting capital for labor, in goods production than in services.

Looking ahead, unless measured productivity in services increases faster, total productivity growth may not accelerate in the major developed countries. Conversely, as the goods-production capability in the developing countries expands over the next few years, high productivity growth is likely to occur there, reducing the gap with the developed countries. And as global differences in wages converge, quality and cost differences of products will narrow. That will intensify global competition over the next decade.

Eva Culen
Ken Goldstein

Sources: U.S. Departments of Labor and Commerce; The Conference Board.

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ECONOMIC ROAD MAPS

Eva Culen, Editor Chuck N. Tow, Chief Chartist
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